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(71)Applicant : MITSUYA SEIKO KK

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(72)Inventor : HANABUSA SABURO
KOIKE TETSUO

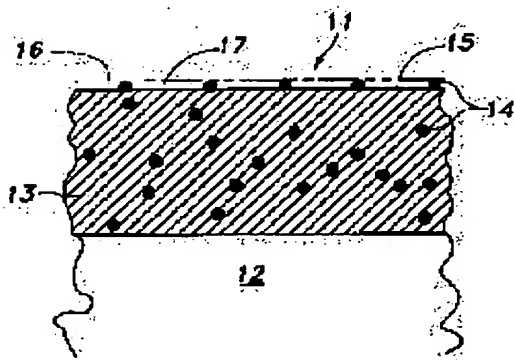
(54) SINTERED COPPER ALLOY SLIDING MATERIAL

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce wear in a sliding material and to improve its seizing resistance to the mating member by executing sintering in such a manner that tungsten component is granularly scattered into a bronze matrix, furthermore locally projecting a part of the tungsten sintered grains to the side of the mating member to form a rugged sliding face and securing a lubricating oil film by rugged surface.

SOLUTION: As for the sliding material, the adoption of a mode of being formed into a high density sintered body, a mode of being formed into a composite material in which a lubricating

synthetic resin material is enclosed into a void of a porous low density sintered body and a mode of being into the one having self-lubricity by impregnating the void of the porous low density sintered body with lubricating oil is possible. The content of tungsten component is preferably controlled to 3 to 13 wt.% to the whole alloy material powder. The sliding material 11 forms a sintered alloy layer on a steel sheet back plate 12, and tungsten sintered grains 14 are sintered into a bronze matrix 13 in a granular dispersed



state. A part of the tungsten sintered grains locally projects onto the surface 15 of the matrix to form ruggedness on a sliding face 16.

LEGAL STATUS

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[Claim(s)]

[Claim 1] The sintered copper alloy system sliding ingredient characterized by for some above-mentioned tungsten sintering grains projecting locally to a phase hand part material side, forming a concave convex sliding surface, and securing the lubricating oil film with a concerned concave convex level difference while being dotted with a tungsten component granular in a bronze matrix and being sintered.

[Claim 2] The above-mentioned sliding ingredient is a sintered copper alloy system sliding ingredient according to claim 1 which is a high density sintered compact.

[Claim 3] The above-mentioned sliding ingredient is a sintered copper alloy system sliding ingredient according to claim 1 which is the composite which made lubricative synthetic-resin material enclose with the opening of a porous low consistency sintered compact.

[Claim 4] The above-mentioned sliding ingredient is a sintered copper alloy system sliding ingredient according to claim 1 which is the self-lubricity which infiltrated the lubricating oil into the opening of a porous low consistency sintered compact.

[Claim 5] The above-mentioned tungsten component is the sintered copper alloy system sliding ingredient given in any of claims 1-4 they are used as 3 - 13% of the weight of the whole alloy ingredient powder.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] the sintered alloy layer to which this invention used copper as the principal component -- a flesh side -- a metal plate -- it is the sintered copper alloy system sliding ingredient used for various kinds of sliding ingredients which form upwards, for example, need a low friction sliding surface for various bearing lists, such as a sliding bearing and a rolling bearing, and is for solving the technical problem which the conventional sliding ingredient which used the copper alloy system of lead bronze and others as the sintered alloy layer especially has.

[0002]

[Description of the Prior Art] Although many things which be made to contain lead (Pb) as a lubricant component in the matrix of copper (Cu)-tin (Sn), and used lead bronze (SAE792, SAE794) by Cu-Sn-Pb as the sintered alloy layer in order to give concordance nature to phase hand part material and to prevent printing had be used with this kind of copper alloy system sliding ingredient, the following troubles be included in this

sliding ingredient.

[0003] ** Pb is paying and dealing with careful cautions so that an environment's may not be spoiled since the matter which can become a public nuisance is included. ** Since the melting point is as low as about 300 degrees C, when the temperature of a sliding surface rises by the use under an elevated temperature, or the sliding friction, Pb should flow out or Pb should close the slotted hole for lubrication sump balls, and reduce sliding performance and have a possibility of burning and carrying out. ** Since Pb has a difficulty in corrosion resistance, the organic-acid film generated by degradation of the additive or lubricating oil contained in the lubricating oil should be easy to be invaded. ** Since compatibility (bond strength) of Pb with Cu whose degree of hardness is a base material low is not good, either, although Pb exposed to the sliding surface functions effectively as a lubricating layer at the time of the first stage, while you use it for a long period of time, have a possibility of wear or dedropping, and the whole sliding surface carrying out metallic contact to phase hand part material, and carrying out abnormality friction easily by sliding with phase hand part material.

[0004] Although the molybdenum (Mo) which is one of the refractory metal ingredients may be made to contain except the above-mentioned lead bronze Although it is difficult to continue at a long period of time and to maintain a sliding surface in the good sliding condition and it may have made ceramics, such as FeB, contain further since the hardness difference of compatibility (bond strength) with a matrix (bronze) is not enough few A difficulty's being in workability and a degree of hardness were too high, and there was no header profit of the suitable ingredient into which has a possibility of damaging phase hand part material, and it is a suitable degree of hardness, and compatibility (bond strength) with a matrix (bronze) also satisfies good conditions.

[0005]

[Problem(s) to be Solved by the Invention] As a result of repeating various examination, this invention person by the suitable degree of hardness then, and by compatibility (bond strength) with a matrix (bronze) also containing in a header the suitable ingredient into which good conditions are satisfied, and making this contain in a matrix (bronze) It is checked that various kinds of troubles in the above-mentioned conventional technique can be canceled, and the new sintered copper alloy system sliding ingredient which had little wear [the conventional thing / especially], and raised the printing-proof engine performance to phase hand part material based on this result is offered.

[0006]

[Means for Solving the Problem] Some above-mentioned tungsten sintering grains project locally to a phase hand part material side, it forms a concave convex sliding surface, and the sintered copper alloy system sliding ingredient by this invention secures the lubricating oil film with a concerned concave convex level difference while

being dotted with a tungsten component granular in a bronze matrix and sintering it. [0007] By high-melting and the high degree of hardness, since coefficient of friction is also small and bond strength with a bronze matrix is also high, a tungsten sintering grain the above-mentioned sliding ingredient For example, when it is used as bearing material, while it is able for there to be little wear and for ill conditions, such as an elevated temperature, and high-speed rotation or the Takani pile, to raise the printing-proof engine performance to phase hand part material to the revolving shaft which is phase hand part material Even if it faces long-term use, the sliding performance which the lubricating oil film by the concave convex level difference was secured, and was stabilized is maintainable.

[0008] Moreover, since lead (Pb) is not made to contain as a lubricant component in a bronze matrix since the same refractory metal ingredient also has [that the technical problem of the above-mentioned ** which leaden use possesses - ** was solved, and a tungsten] the melting point and a higher degree of hardness compared with molybdenum and especially bond strength with a bronze matrix is alike and high Like [at the time of making ceramics, such as that the difference of the above-mentioned effectiveness appears notably, and FeB, contain], there are not phase hand part material and a big hardness difference, since there is moderate familiarity nature, phase hand part material is not damaged and technical problems of the conventional technique, such as an advantageous thing, are solved also in respect of workability.

[0009] The mode which uses the above-mentioned sliding ingredient as a high density sintered compact, the mode used as the composite which made lubricative synthetic-resin material enclose with the opening of a porous low consistency sintered compact, It is possible to take the mode made into the self-lubricity which infiltrated the lubricating oil into the opening of a porous low consistency sintered compact. Moreover, the above-mentioned tungsten component can change and use a mixed ratio according to an application, description or an operating environment of phase hand part material, etc., and its use in within the limits of 3 - 13% of the weight of the whole alloy ingredient powder is the most desirable in that case.

[0010] Among these, in the case of a high density sintered compact, rigidity is high and a sliding ingredient with the high bond strength of a tungsten sintering grain is obtained to a bronze matrix. In the case of the composite of a low consistency sintered compact and synthetic-resin material While employing efficiently the advantage of the metal material to which thermal conductivity can absorb or distribute sliding frictional heat well, and the advantage of the resin material which can reduce coefficient of friction at the time of low-speed sliding and improving familiarity at the time of the early stages of phase hand part material especially by enclosure resin material When it transfers while in use, it is effective in preventing printing, and in the self-lubricity into which the lubricating oil was infiltrated, there is an advantage which can be used

without supplying with oil from the outside unlike front 2 persons and which can be cheaply manufactured with it being simple.

[0011]

[Embodiment of the Invention] If the suitable operation gestalt of the sintered copper alloy system sliding ingredient by this invention is explained in detail with reference to an attached drawing below As drawing 1 shows a typical fragmentary sectional view, as for the sliding ingredient 11 of the 1st operation gestalt, a sintered alloy layer is formed on the steel plate back plate 12. It is dotted with this sintered alloy layer in the state of distribution with the granular tungsten (W) component 14 in the copper (Cu)-tin (Sn) alloy 13, i.e., a bronze matrix, and it is sintered. Some tungsten sintering grains 14 with which this sintered compact is a high density sintered compact which lessened the internal opening with strip processing, and it was dotted are making the sliding surface 16 to a projection and phase hand part material (not shown) form in up to the matrix front face 15 locally at irregularity.

[0012] The sliding surface 16 by the irregularity formed with the tungsten sintering grain 14 While the front-face side of the projecting tungsten sintering grain 14 pays the main slide contact to phase hand part material Since the oil film 17 to the lubricating oil which refueled the level difference which the cut matrix front face 15 paid the slide contact auxiliary, and was formed between the matrix front faces 15 was formed Sliding frictional resistance is mitigated and the good lubrication condition continued and stabilized at the long period of time can be maintained.

[0013] Especially the sintered alloy layer containing the tungsten sintering grain 14 Since the melting point (3410 degrees C) is high in a degree-of-hardness (about 350 to 500 Vickers) list compared with the bronze matrix 13, of course, a tungsten (W) lead (Pb) A tungsten (W) can maintain a sliding condition without printing or sliding unevenness also for ** by not wearing out easily like the lead in lead bronze, or not fusing, without dropping out by a sliding friction etc., since compatibility with the bronze matrix 13 is good and bond strength is high.

[0014] Moreover, since the degree of hardness of Mo is not so high as W as compared with the case where molybdenum (Mo) is made to contain in a bronze matrix and (about 200 to 250 Vickers) there are few hardness differences with a bronze matrix While it is difficult to continue and to secure the level difference for the above-mentioned oil film formation by wear etc. at a long period of time, there are bond strength with a bronze matrix and a possibility of gnawing between phase hand part material and generating a phenomenon according to Mo omission in a sliding surface since it is not high.

[0015] In case the sliding ingredient 11 by the above-mentioned high density sintered compact is manufactured, the alloy ingredient powder which mixed tungsten powder by the predetermined weight ratio to bronze powder is sprinkled on the steel plate back plate 12, it sinters in RX reducing atmosphere, and a porous low consistency sintered

compact is built, and after it carries out strip processing of this low consistency sintered compact and it carries out densification, it sinters again, and the alloy layer by the high density sintered compact is made to form.

[0016] The tungsten sintering grain 14 made to contain in the sliding ingredient 11 When the ratio is lessened (for example, 1% or less) Since the heights of W which forms a sliding surface 16 decrease and the matrix front face 15 ****s to phase hand part material, printing and wear are produced. Conversely, when the ratio is made [many / (for example 20% or more)], while the heights of W increase and coefficient of friction in a sliding surface 16 rises, the oil film 17 to a lubricating oil becomes is hard to be formed, and lubricity is spoiled.

[0017] Therefore, although it is necessary to set the tungsten sintering grain 14 in the sliding ingredient 11 as the value of the request which suits the service condition of phase hand part material or others, it is most desirable to make it contain in 3 - 13% of the weight of the range to the whole alloy ingredient powder which forms a sintered alloy layer as checked also in the example mentioned later.

[0018] Next, the sliding ingredient 21 of the 2nd operation gestalt by this invention Although a sintered alloy layer is formed on the steel plate back plate 22 as drawing 2 shows a typical fragmentary sectional view, and it is dotted with this sintered alloy layer in the bronze matrix 23 like the case of the 1st sliding ingredient 11 in the state of distribution with the granular tungsten (W) component 24 and it is sintered This sintered compact is a low consistency sintered compact which made [many / (voidage is about 50% of the whole)] the internal opening 28 by porosity.

[0019] Some dotted tungsten sintering grains 24 locally this sliding ingredient 21 to up to the matrix front face 25 A projection, Make the sliding surface 26 to phase hand part material (not shown) form in irregularity, and like the case of the 1st sliding ingredient 11, auxiliary, while the matrix front face 25 pays a slide contact, respectively, the front-face side of the tungsten sintering grain 24 the main slide contact to phase hand part material The good lubrication condition which sliding frictional resistance was mitigated, and was continued and stabilized at the long period of time by forming an oil film 27 in the level difference on the front face 25 of a matrix is maintained.

[0020] Moreover, although synthetic-resin material with small coefficient of friction is enclosed with the opening 28 formed in the sintered alloy layer and it is made to unite with it with lubricity Reduction of coefficient of friction at the time of low-speed sliding which is hard to be obtained by using the composite of this sintered metal material and enclosure resin material in a hard metal material independent, Absorption or distribution is aimed at for the sliding frictional heat generated in the sliding surface which is hard to be obtained if independent. the resin material which is not good as for thermal conductivity -- When enclosure resin material has the good concordance operation over phase hand part material and it transfers it, it adheres to the matrix

front face 25 or phase hand part material, and can prevent printing.

[0021] As enclosure resin material, the independent or improvement in abrasion resistance [list / of coefficient of friction / in / in inside / in the polytetrafluoroethylene (PTFE) of a fluororesin system / a low speed / although two or more sorts can be mixed and used / reduction effectiveness] can expect resin, such as a fluororesin, polyamide resin, polyacetal resin, polyimide resin, phenol resin, polyphenylene sulfide resin, and polyether ketone resin, and it is checking especially that use of the phenol resin containing PTFE is desirable.

[0022] In case the above-mentioned sliding ingredient 21 is manufactured, the alloy ingredient powder which mixed tungsten powder by the predetermined weight ratio to bronze powder is sprinkled on the steel plate back plate 22. Sinter in RX reducing atmosphere and build the sintered alloy layer of the low consistency in porosity, and enclose synthetic-resin material with lubricity with the opening 28 formed in this sintered alloy layer, and it is made to unite with it, and can manufacture cheaply by one sintering compared with the 1st sliding ingredient 11 made into high density.

[0023] Furthermore, without enclosing synthetic-resin material with the opening 28 in the sliding ingredient 21 of the 2nd operation gestalt as a sliding ingredient (illustration is omitted) of the 3rd operation gestalt by this invention In order to make [many / (it is about 10 - 30% at a volume ratio)] an oil content as it is the oil impregnation sliding ingredient into which the lubricating oil was infiltrated beforehand instead and used from the former While taking the gestalt which is made to increase the thickness of a porous low consistency sintered alloy layer, and omits the steel plate back plate 22, it is the low consistency sintered compact made into the voidage which suits the above-mentioned oil content.

[0024] While the above-mentioned oil impregnation sliding ingredient is self-oil supply whose lubricating oil in an opening oozes out by the pump action, and forms an oil film in a sliding surface and has the simplicity which can be used without supplying with oil from the outside like the sliding ingredients 11 and 21 Although abrasion resistance and printing-proof nature are improved by the sliding surface formed in concave convex with the tungsten sintering grain Since a fluid lubrication condition is not acquired like the problem of the porosity reinforcement of a matrix, and the sliding ingredients 11 and 21 but it will be in a boundary lubrication condition, the use which limited the application in consideration of there being a difficulty is required for use by the low speed and the Takani pile.

[0025] In addition, although there is the approach of mixing and sintering solid lubricants, such as a graphite and molybdenum disulfide, to copper alloy powder instead of lead (Pb) as a technique currently carried out from the former Even if it applies this approach to the above-mentioned sliding ingredient by this invention, it is effective, and since there is no addition effectiveness at less than 0.1%, the bond

strength of an alloy is reduced at 3% or more, it becomes brittle and wear is promoted, the content ratio of this solid lubricant has about 0.2 - 2.5% of the weight of desirable combination.

[0026]

[Example] As opposed to the apparent density of 2.6g, Sn9.0%, and bronze powder with a grain size of 150 micrometers or less (Example 1) Tungsten (W) powder with a grain size of 7.6-12 micrometers is mixed by the predetermined weight ratio. Sprinkle on the steel plate back plate which had these alloy ingredient powder washed, and 1st sintering is performed for 30 minutes at the temperature of 860 degrees C into RX reducing atmosphere. While roll rolling raises an alloy consistency after cooling, it finishes in predetermined thickness. 2nd sintering was performed on the still more nearly same conditions as the 1st time, and the degree of coupling of a particle was raised, and distortion by work hardening at the time of rolling was removed, and the total thickness containing the steel plate back plate which formed the alloy layer with a width of face of 150mm by 0.5mm in thickness considered as the sintered copper alloy system sliding ingredient which is 1.8mm.

[0027] As opposed to the apparent density of 2.6g, Sn9.0%, and bronze powder with a grain size of 150 micrometers or less (Example 2) Tungsten (W) powder with a grain size of 7.6-12 micrometers is mixed by the predetermined weight ratio. After sprinkling on the steel plate back plate which had these alloy ingredient powder washed and sintering for 30 minutes at the temperature of 860 degrees C in RX reducing atmosphere Sink in and the phenol resin which contains PTFE(poly ETORAFURORO ethylene)30% to the opening (voidage is about 50% of the whole) formed by this is stiffened. The total thickness containing the steel plate back plate which formed the alloy layer with a width of face of 150mm by 0.5mm in thickness considered as the sintered copper alloy system sliding ingredient which is 1.8mm.

[0028] The sliding ingredient of these examples 1 and 2 the weight ratio of W powder in the ingredient powder which forms an alloy layer Although it manufactured in the condition of having set up to 3%, 6.5%, and 13% in the case of the example 1, and having set up to 3%, respectively in the case of the example 2 and the comparative study (the printing-proof trials 1 and 2, abrasion test) with the samples 5-9 by the conventional technique was performed by making this into samples 1-4 The result is as in Table 1, and the test condition is as follows.

[0029]

[Table 1]

表 1

試料		合金成分(重量%)						焼付試験		摩耗試験	
		青銅系合金			潤滑材			(1) 焼付 荷重 (MPa)	(2) 焼付 荷重 (N)	摩耗 量 (μm)	摩耗 件数
No.	形態	Cu	Sn	W	Pb	FeB	Mo				
1	実施例 1-1	残部	8.7	3	—	—	—	6.6	—	8	0.09
2	実施例 1-2	#	8.4	6.5	—	—	—	8.6	15×10^3	6	0.05
3	実施例 1-3	#	7.8	13	—	—	—	7.4	—	6	0.07
4	実施例 2	#	8.7	3	—	—	—	7.4	—	7	0.05
5	従来例 1	#	10	—	10	—	—	4.3	—	17	0.10
6	従来例 2	#	3.5	—	23	—	—	5.2	2.5×10^4	79	0.10
7	従来例 3	#	9	—	0	—	—	3.5	—	40	0.10
8	従来例 4	#	8.7	—	—	3	—	5.0	2×10^3	56	0.10
9	従来例 5	#	8.6	—	—	—	5	5.0	2.1×10^3	62	0.10

* 試料4は試料1の50%空隙部にPTFE入りフェノール樹脂を含浸

[0030] (Printing-proof trial 1)

Testing device: Ring-on plate mold friction wear machine load : It is a rate until it raises a linear from 200Ns (1Mpa) and 200 degrees C or frictional force amounts [friction temperature] to 490 Ns. : 4800 r/min (347 m/min)

Lubricating-oil agent: Gas oil (25 cc/min)

Oil temperature : 80 degree-C phase hand-part material: SCM420H (HRC55-60 surface roughness 1.0S)

[0031] (Printing-proof trial 2)

Testing device: Bearing dynamic load testing machine (refer to drawing 3)

Number degree-of-hardness HRC[of ****] 58 surface roughness 0.58a lubricating-oil agent: SAE 30 100 - 300 cc/min shower concomitant use oil supply temperature of

140**10 degrees C : 4000 r/m load : It is a bush:psi55.5xpsi52x10 partner shaft until it accumulates 100Ns every 5 minutes from 600Ns and 200 degrees C or frictional force amounts [the tooth-back temperature of a test bush] to 50 Ns. : Quality-of-the-material S45C [0032] Quench-and-temper (Abrasion test)

Testing device: Ring-on plate mold friction wear machine load : 200Ns (planar pressure 10Mpa)

Rate :1000 r/min (72 m/min)

sliding time amount: -- 20Hrs lubricating oil agent: -- motor oil 30 (25 cc/min)

Oil temperature : 80 degree-C phase hand-part material: SCM420H (HRC55-60 surface roughness 1.0S)

[0033] The sintered copper alloy system sliding ingredient based on this invention is a good thing with little [and] printing which also has few abrasion loss compared with this kind by the conventional example of sliding ingredient so that clearly [these test results / in Table 1].

[Brief Description of the Drawings]

[Drawing 1] The typical fragmentary sectional view based on the 1st [using the high density sintered compact of the sintered copper alloy system sliding ingredient by this invention] operation gestalt.

[Drawing 2] The typical fragmentary sectional view based on the 2nd [using the composite of the porosity low consistency sintered compact and synthetic-resin material of a sintered copper alloy system sliding ingredient by this invention] operation gestalt.

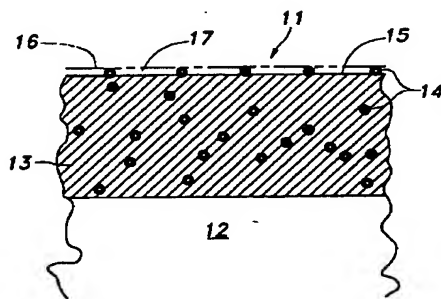
[Drawing 3] The typical front view of the bearing dynamic load testing machine used for the printing-proof trial 2.

[Description of Notations]

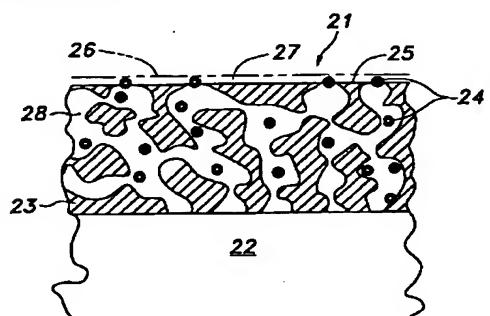
- 11 21 Sliding ingredient
- 12 22 Steel plate back plate
- 13 23 Bronze matrix
- 14 24 Tungsten sintering grain
- 15 25 Matrix front face
- 16 26 Sliding surface
- 17 27 Oil film
- 28 Opening

DRAWINGS

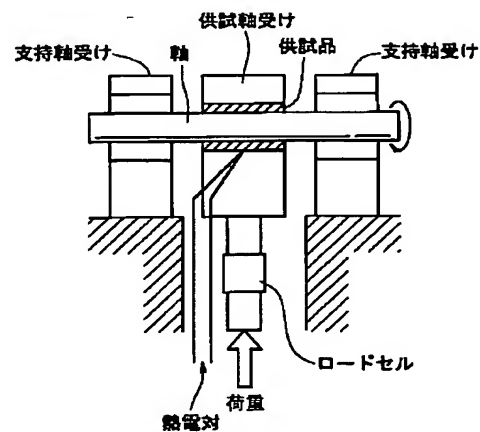
[Drawing 1]



[Drawing 2]



[Drawing 3]



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